Past and Future of Nearshore Processes Research, Workshop Results

- Nicole Elko, American Shore and Beach Preservation Association

Asbury "Abby" Sallenger

… inspiring, providing vision, leading

June 11, 1949 - February 5, 2013

Duck 1982, 84 - whenever!

Curt, Abby, Rob and Bill
1985, "DUCK82 – a coastal storm processes experiment", *19th ICCE*

Past & Present FRF Chiefs (all attended)

- Curt Mason: 1979 – 1987
- Bill Birkemeier: 1987 – 2008
- Jesse McNinch: 2008 – 2013
- Jeff Waters: 2013 – present

Predictive Skill

- Good:
  - Landfall
  - Waves & longshore currents
- Not as good:
  - Flooding
  - Shoreline change
  - Breaching

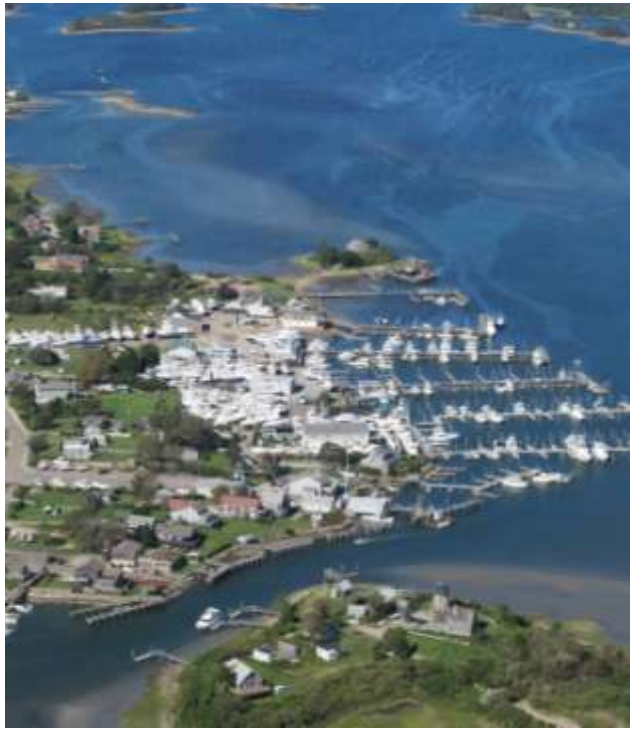
Predictive Skill

- Good:
  - Landfall
  - Waves & longshore currents

- White Paper, draft
- NRC type report
- https://scripps.ucsd.edu/centers/nearshorefuture/

Future of Nearshore Process Research

Looking Forward: Programmatic Challenges and Opportunities



- **Improving Coastal Analysis Tools**
  - Data collection for **waves in the floodplain**
  - Wave runup and overtopping
  - Evaluation of the 540 SF rule for dune erosion
  - Reduce cost/computational burden
- **Calculating Uncertainties**
  - Improve quantification of uncertainties for storm surge, wave height and runup
  - Tools to communicate uncertainty to the public
  - Understand the real impacts of uncertainty
- **Understanding the Whole Coastal Hazard**
  - How do the individual components play into the whole hazard?
  - Consider long term erosion, sea level rise, climate change, debris issues
  - FEMA is moving towards communication of the full hazard

Sea-level rise & coastal erosion threatens resources

EXPERIENCE YOUR AMERICA


Fort Jefferson, Florida

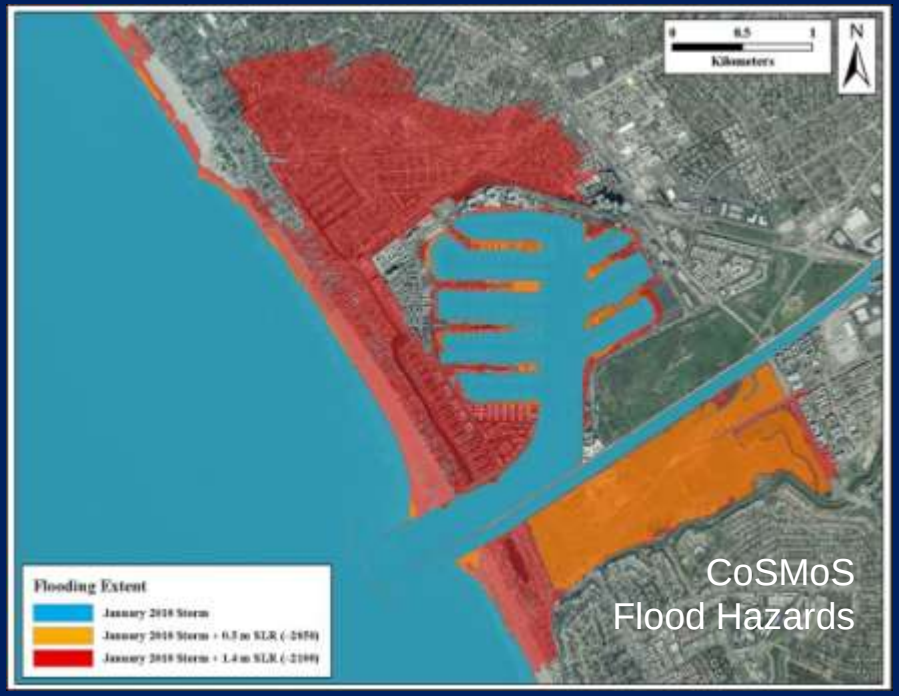

Jamestown Island, Virginia

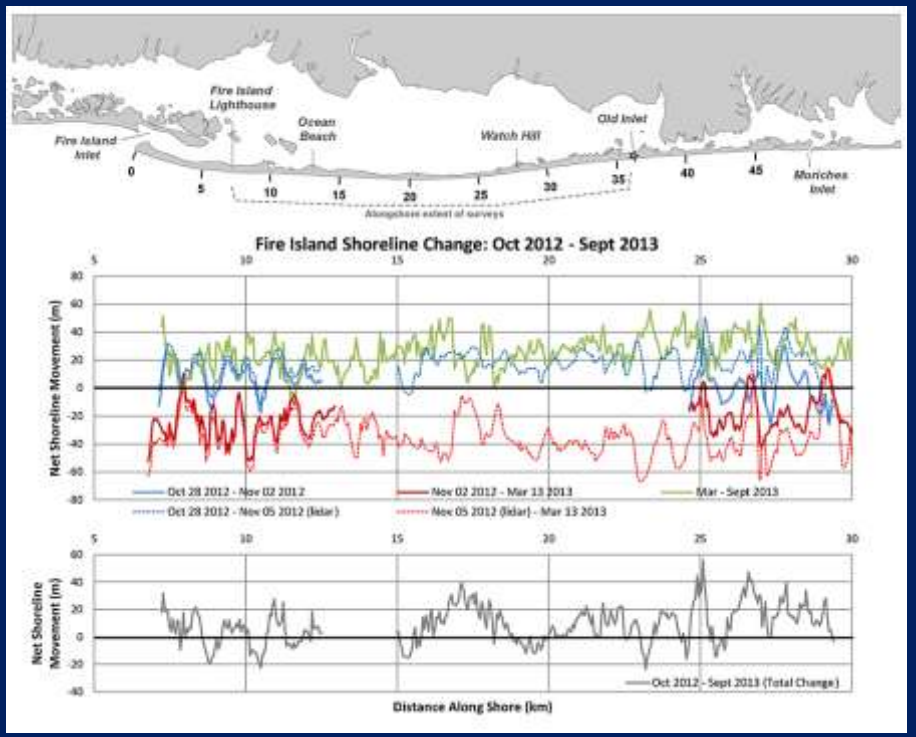

Kaloko-Honokohau, Hawaii

Information Needs are Many and Complex

- **Coastal hazards, including fundamental nearshore processes**
- **Rivers, estuaries, and the coastal ocean – the interconnected system**
- **Ecosystems and "Natural Defenses"**
- **Human dimension, particularly as it influences the above**

The USGS CMGP projects are sharing knowledge, data, and tools, all based on solid research, with those in the coastal community who require unbiased information to make important economic, social, and ecological decisions





Challenges:

- Changing climate
- Integration (scales, processes)
- Sediment transport, budgets

USGS science for a changing world

Coastal Resilience

The ability of a system to resist, recover &/or adapt to the stresses of adverse events

- **Engineering:** resist damage, or return to a prior relatively stable state following a disturbance.
- **Ecological:** resist damage, or self-organize into a new configuration after disturbance.
- **Community/Social:** learn and adapt to avoid loss in functionality; develop new functions in response to disturbance.

Schultz et al. (2012)

Military Civil Works

USGS science for a changing world

Sandy Comp Study

FEMA

NSF

EPA

Military

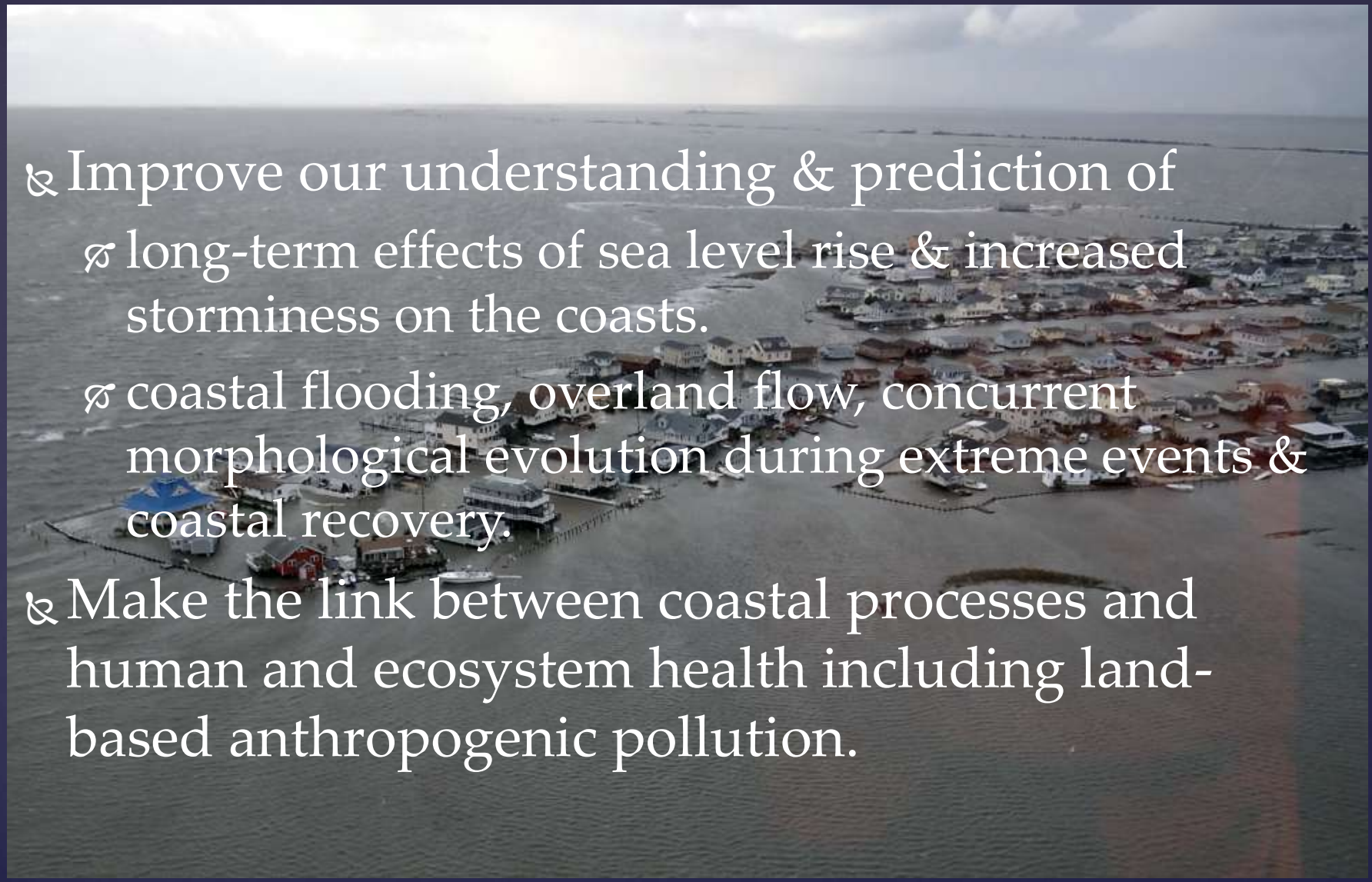
USAID

NOAA

“This is not your father’s Nearshore”

Common elements of societal needs

- dependence on accurate/updated data
- seamless characterization of processes across the nearshore system
  - ocean -overland - coastal plains/estuaries
- quantification of uncertainties
- multidisciplinary integration of process understanding



- Improve our understanding & prediction of
  - long-term effects of sea level rise & increased storminess on the coasts.
  - coastal flooding, overland flow, concurrent morphological evolution during extreme events & coastal recovery.
- Make the link between coastal processes and human and ecosystem health including land-based anthropogenic pollution.

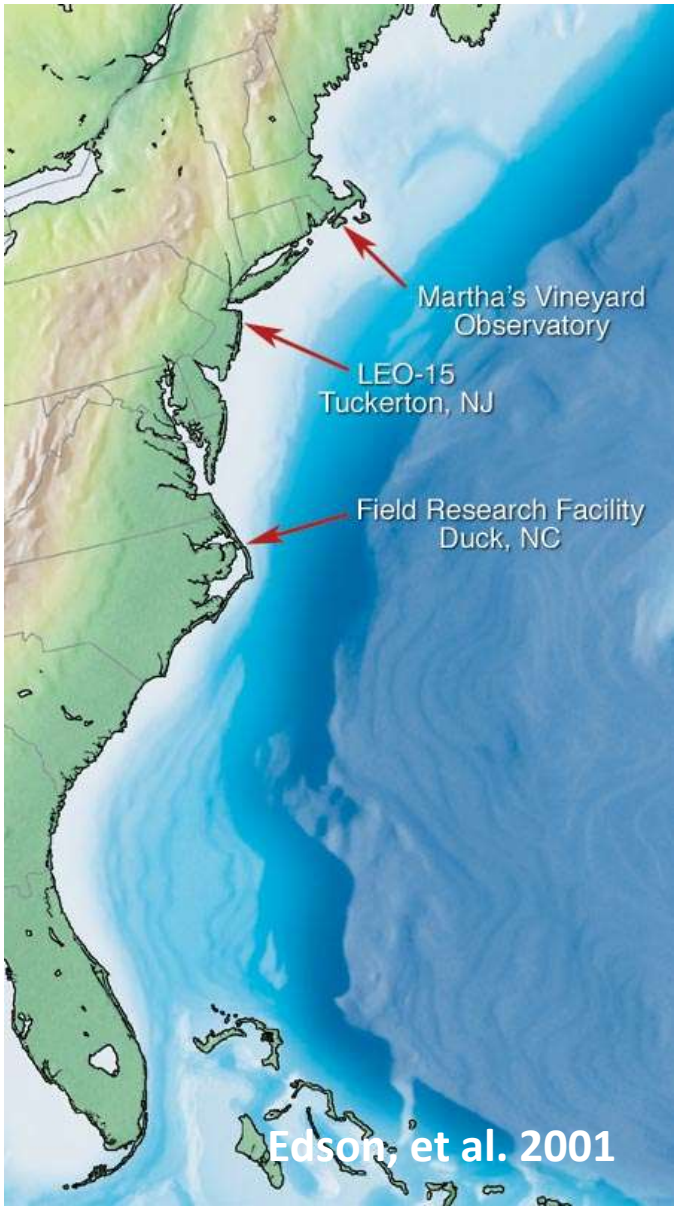
Broad research goals

Long-term nearshore process research

- Natural beaches
  - Defining how short- (storms, human activities) and long-term process (SLR, sediment supply) are connected
    - What are the feedback mechanisms?
  - Understanding how the cumulative changes induced by episodic events and subsequent recovery drive long-term morphologic evolution
  - Developing the ability to predict coastal change over a range of sea level rise rates and changing storm climatologies for a variety of geomorphic environments
- Anthropogenic coastal systems
  - how will the availability of sand impact the cost and sustainability of nourishment?;
  - how do coastal property values evolve as sea level rises, storm characteristics change, or policies such as insurance rates or nourishment subsidies are altered?;

How Long are our Time Series?

- NOAA Water Levels (long time)
- NDBC Buoys & C-MAN (1960's)
- CDIP (1975)
- FRF (1978)
- Argus (1986, 1992)
- LIDAR (1996)
- Leo15 (1996)
- MVCO (2000)
- S. Carolina (2000?)
- Kilo Nalu (2004)
- Others … (inlets, estuaries, profiles)



CHALLENGES: Long-term nearshore process research

- incorporating the episodic, high-stress and regime-shifting influence of storms and the slow, low-amplitude recovery processes into long-term simulations;
- investigating the coupling of processes to determine what hydrodynamic phenomena (e.g., undertow, surfzone eddies, wave asymmetry) dominate sediment transport over the long-term
- avoiding rapid scaling up of morphodynamic evolution over time that excludes long-term feedbacks;
- coupling between physical and biological processes, vital in shaping coastal regions;
- simulating changing anthropogenic interactions and feedbacks with coastal morphology

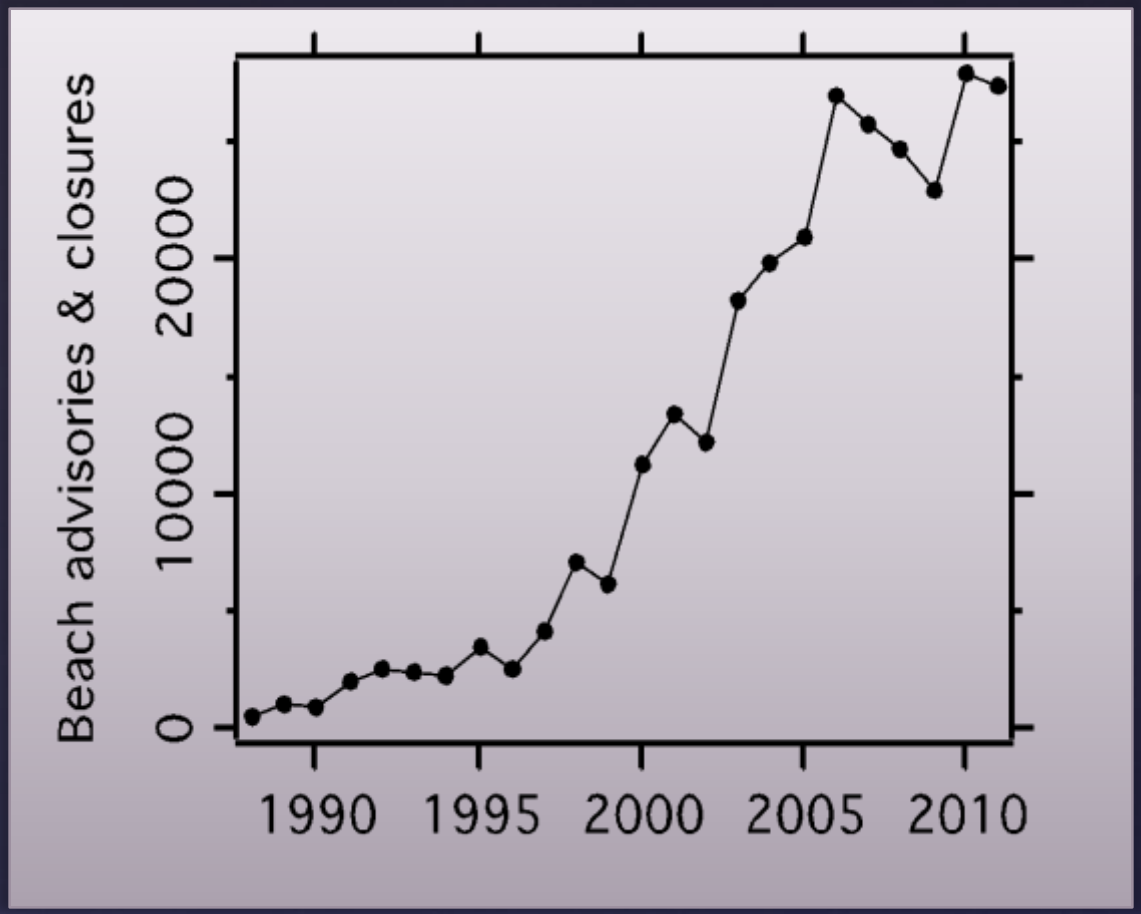
Extreme Events

Extreme Events

- Characteristics of the extreme events
- Wave transformation
- Coastal flooding
  - Overland flow/groundwater
  - Runup
  - Turbulenece
- Morphologic evolution & sediment transport
  - Mixed-sediment transport
- Coupling with other coastal systems
- Infrastructure & economic impacts

Human & Ecosystem Health

- Goal: Develop a predictive real-time nearshore pollutant modeling capability which will require expanding our knowledge of the physics, chemistry, and biology of the nearshore
- Threats: exposure to polluted nearshore waters, excess nutrient input (eutrophication) from terrestrial anthropogenic sources, such as sewage, agriculture, and urban runoff which can result in harmful algal blooms
- Multi-disciplinary problem: understanding the process of transport and dilution in the nearshore (tracer studies)
- Results: smarter beach closures, smarter nearshore aquaculture, & improved mitigation/regulatory policies



Human & Ecosystem Health: Coupling with Nearshore Processes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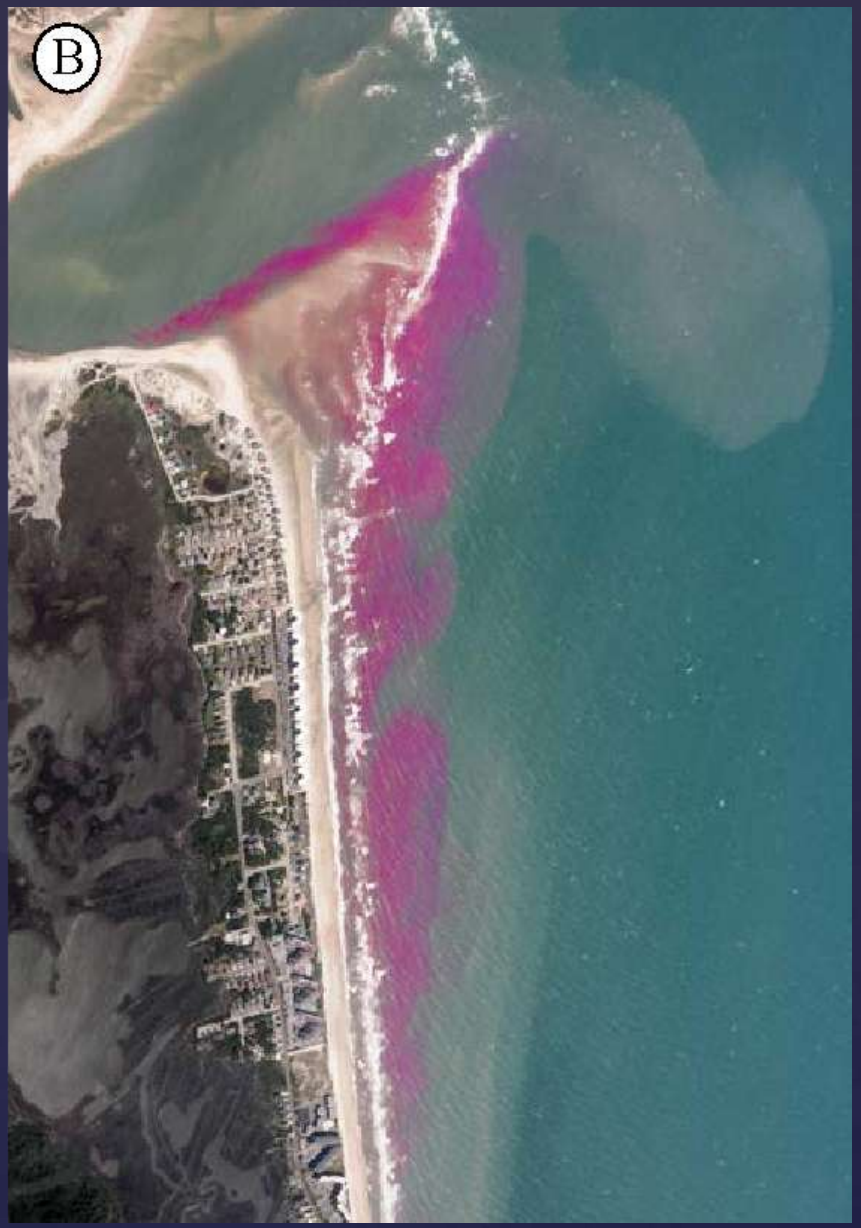
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Enabling Infrastructure: Observations

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Enabling Infrastructure: Modeling tools

- Improvement to coupling different types of models
- Issues related to spatial & temporal resolution
- Improvement of data assimilation techniques for nearshore
- Sediment transport modeling
  - Development/evaluation of sediment pickup functions
  - Multi-phase model development/validation
- Development of real-time models to provide immediate guidance to decision makers
- Integrating models over spatial/temporal scales

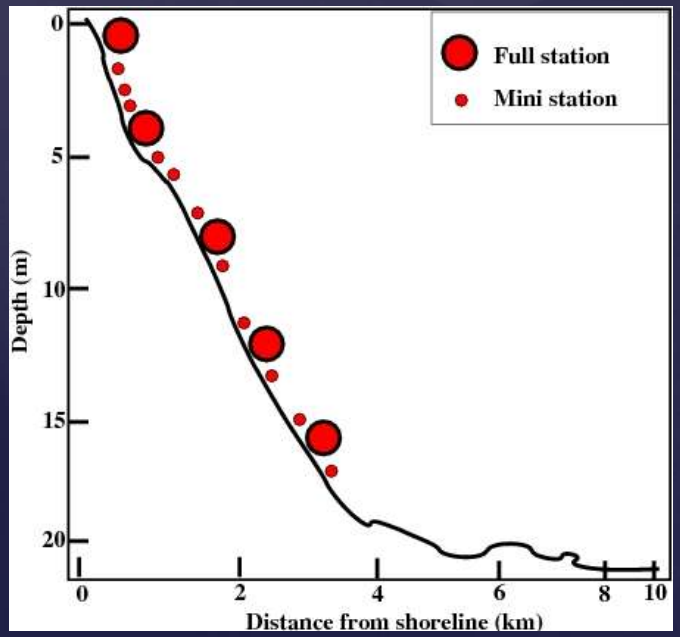
Enabling Infrastructure: Communication, community, collaboration

- Interagency coordination
- Nearshore community database
  - Partner with OOI
- Communicating model results to users
  - Kelly et al., 2013
- Continue long-time series data collection
- Future collaborative, applied beach nourishment field experiment
- Utilize social media to collect data & communicate risk during extreme events

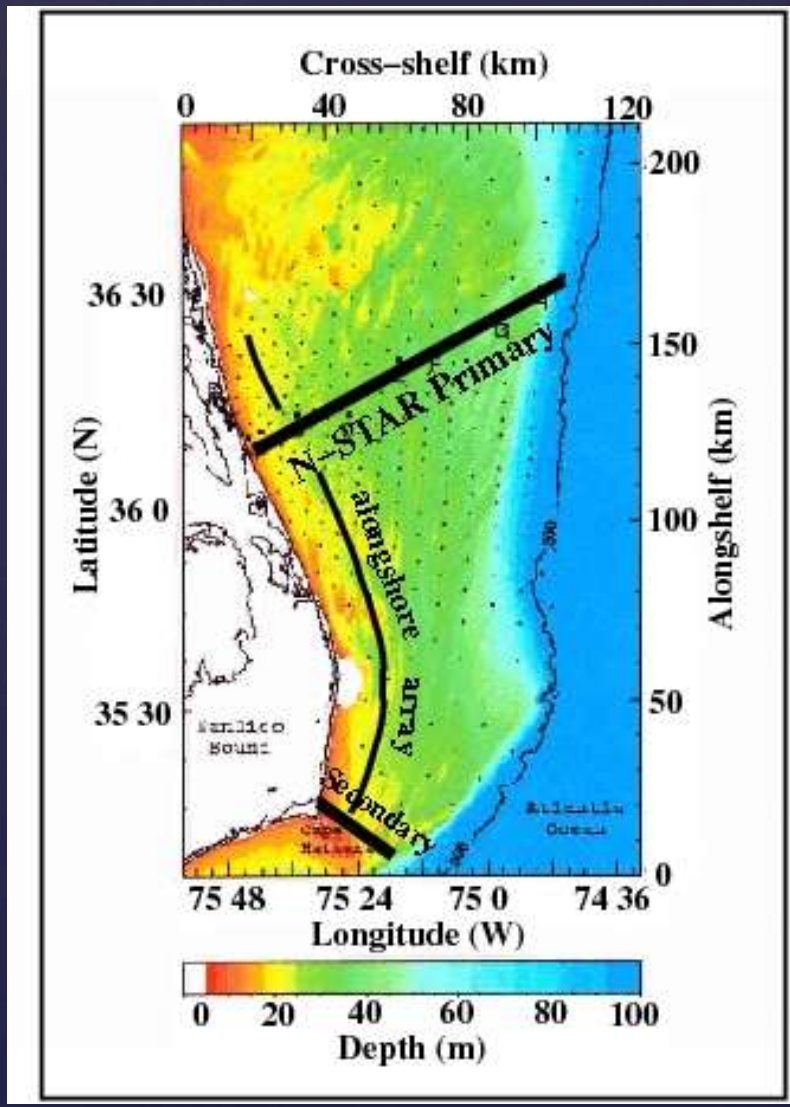
Should we expand our “observatories” to make better, more dense measurements?

OOI (1 - 20 m) N-STAR

- variables (u,v,w,T,S,Chl,Turb,Chem)
- nodes (time series)
- small-boat surveys (spatial profiles)



Elgar, et al., 2006



Enabling Infrastructure: Communication, community, collaboration

- Nearshore Advisory Council goals
- foster continued community collaboration,
- structure the nearshore community,
- represent the nearshore community (a “voice”) to society and communicate with the public,
- communicate vision, strategy, and approach to political leaders who can support new effort and expect tangible benefits for society, and
- advocate for funding from government agencies, Congress and the Administration for a sustained research program.

Questions?

Nicole Elko
nelko@elkocoastal.com
ASBPA Secretary